

GROWTH & DEVELOPMENT

Growth

- It is increase in the size of the body as a whole or of its individual parts, due to multiplication of cells & intracellular substance.

Development

- It is functional maturation of organs and systems with acquisition of skills and adaptation to society.
- Both growth & development go parallel to each other during normal life. However sometimes there is delay or stoppage in one of them in some pathological conditions.

Periods of human life

1. Intrauterine life

- Embryonic life ---- 1st trimester
- Fetal life ---- 2nd & 3rd trimester

2. Peri-natal:

- It extends from the start of labor till the end of the 1st 24 hr of life.

3. Neonatal period:

- The first 4 wks of life (28 days).

4. Infancy:

- Early infancy: 1st year.
- Late infancy: 2nd year

5. Childhood period.

- Preschool age: 2-6 years.
- School age: 6-10 years in females.
6-12 years in males..

6. Adolescence:

- Females: 10 -15 years.
- Males: 12-17 years.

7. Adulthood

- Females >15
- Males >17.

N.B.: There is overlap between peri natal & neonatal.

Factors Affecting Growth & development

1- Genetic factors.

2- Environmental factors:

- Racial.
- Geographical.
- Nutritional.

3- Psychological & emotional factors. → Mother --- infant relationship.

4- Endocrinal factors

5- Activities.

6- Chronic illness.

7- Secular trend

8- Socioeconomic factors.

Assessment of growth

Growth assessment by anthropometric measurements can be done through

A. Non-specific (basic) measurements:

Weight, height or length, body proportions, growth velocity, mid-arm circumference, skin fold thickness & skull circumference.

Normal body proportions are:

- o Span to total height ratio around 1.0 at all ages.
- o Upper to lower segment ratio is around 1.7 in the neonatal period, decreasing to 1.4 at age 4-5 years & to 1.0 by age 10-12 years

B. Specific measurements:

Chest circumference & thoracic index, these can be done for special children for special purposes as for research work

Weight

- The weight of the newborn infant averages about 3.25 Kg.
- There is physiological weight loss which is about 5-10 % of body weight. It is regained back by 10 days of age.
- In the 1st 4 months there is weight increase by $\frac{1}{4}$ kg/ month.
- In the 2nd 4 months there is weight increase by $\frac{1}{2}$ kg / month.
- In the 3rd 4 months there is weight increase by $\frac{1}{4}$ kg/month.
- So the baby double his weight by the 4th month & triples his weight by the end of the 1st year.

Weight	Kg
At birth	3-3.5
3-12 months	$\frac{\text{Age (m)} + 9}{2}$
1-6 years	$\text{Age (years)} \times 2 + 8$
7-12 years	$\frac{\text{Age (years)} \times 7 - 5}{2}$

Height or Length

- Length: measured in infancy period (up to 2 years) or in children who are unable to stand without assistant.
- Height: measured in children who are able to stand without assistant.

Height	Centimeters
At birth	50
At 1 year	75
2-12 years	$\text{Age (years)} \times 5 + 80$ Or $\text{Age (years)} \times 6 + 77$

Ossaceous development

Bone age can be determined by the appearance of ossific centers in X-ray films as follows:

At birth there are 6 centers of ossification:

1. Distal end of the femur.
2. Proximal end of the tibia.
3. Talus.
4. Calcaneous.
5. Cuboids.
6. Head of the humerus.

The carpal bones:

They are 8 in number:

1st one appears in the 1st 6 months.

2nd one appears at the end of the 1st year.

Then, one carpal bone each year up to 6 years.

The 8th carpal bone appears at 12 years.

Causes of delayed bone age:

1. Hypothyroidism.
2. Hypopituitarism.
3. Hypoparathyroidism.
4. Severe under & mal-nutrition.

Causes of advanced bone age:

1. Thyrotoxicosis.
2. Excess GH.
3. Hyperparathyroidism.
4. Precocious puberty.
5. Congenital adrenal hyperplasia.
6. Iatrogenic with androgen therapy.

Skin fold thickness

This measures the subcutaneous fat because we measure the skin & S.C. tissue, this is measured over:

1. The biceps.
2. The triceps
3. Subscapular area.
4. Supra-iliac areas.

It can be measured by "Harpender's skin fold caliper".

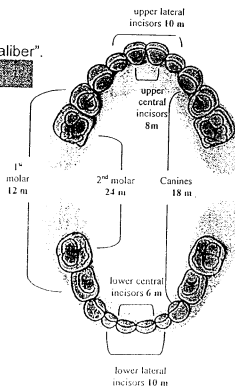
Skull circumference, fontanels

Look.....Clinical note.

Teething:**1. Temporary (1^{ry} milk, deciduous) teeth**

They are 20 in number, 10 in each jaw.

- At 6 months lower central incisors.
- 8 months upper central incisors.
- 10 months upper lateral incisors.
- 10-12 months lower lateral incisors.
- 12-15 months 1st molars.
- 18 months canines.
- 24 months 2nd molars.



2. Permanent teeth:

They are 32 in number.

- At 6 Years 1st molar.
- 8 years central incisors.
- 9 years lateral incisors.
- 10 years canines.
- 11 years 1st premolars.
- 12 years 2nd premolars.
- 13 years 2nd molars.
- 17-25 years 3rd molars.

Causes of delayed teething:

1. Rickets.
2. Cretinism.
3. Down S.
4. Under-nutrition & malnutrition.

Premature eruption of teeth: in congenital syphilis.

Analysis and interpretation of growth chart:

- The standard growth chart is based on data collected from a big number of infants and children from birth to 18 years in a given community.
- It is composed of several percentile curves most important are weight, height or length and head circumference for age.
- The X-axis on the curve represents the age and the measured variable on the axis. The percentile curve indicates the percentage of children at a given age whose measured value falls below the corresponding value indicated on the axis.
- By definition the 50th percentile is the median i.e. the value above (and below), which 50% of the observed values fall.
- The normal range of the observed variable lies between the 5th and 95th percentile lines. Values between 3rd and 5th percentiles and those between 95th and 97th percentile lines are considered suspicious of abnormality and should be followed up more frequently. Values below 3rd and above 97th percentile are definitely abnormal.
- Disparities in growth between developed and developing countries reflect nutritional rather than genetic differences.
- Curves may be less applicable to adolescents as growth during adolescence is temporally linked to the onset of puberty, which varies widely.
- Specialized charts have also been developed for children with various conditions, including Down, Turner, Klinefelter syndromes and achondroplasia.

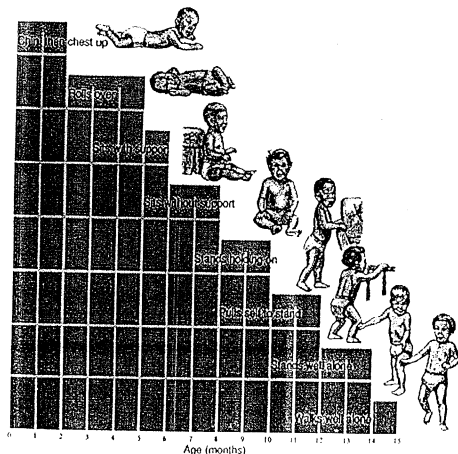
Assessment of Development

Characteristic features of development:

- 1- It is a continuous process.
- 2- It always follows the same pattern.
- 3- It is always cephalo-caudal progress.

Gross motor development:

2 month	Chin then chest up
3 months	Neck support
6 month	Rolls over
4-6 month	sitting supported
6-8 month	sitting unsupported
8-10 month	Stands hold on
9-12 month	Pull himself to stand & crawls free
12-14 month	Stand well alone & walk supported with one hand.
11-15 month	Walk well alone
18 months	Ascending upstairs in a child manner.
24 months	Descending in a child manner.
3 years	Ascending upstairs in an adult manner
4 years	Descending in an adult manner
5 years	Can hold on one limb.



Fine motor (Manipulative)

- At 4 m ⇒ Brings hands together to play with them
 6m ⇒ Grasp bottle, bring toes to mouth.
 7m ⇒ can transfer a toy from one hand to another.
 9m ⇒ can hold objects between thumb & forefingers.
 10 m ⇒ Point at object with index finger.



6 month

7 month

9 month

Speech:

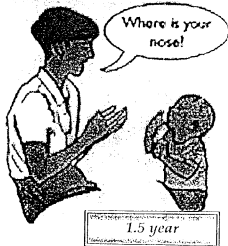
- At 6 weeks Throaty sounds
 6ms 1 syllable of word e.g. pa, ma, da
 9 mo 2 syllables of word e.g. papa, mama, dada
 1 yr one & two words:
 1.5 yr 3 - 10 words (not necessarily meaningful) , show parts of the body
 2 yr 2 words in a sentence
 3 yr says his name, age, sex.
 4-5 yr can tell a story.



9 month



2 year



Where is your nose?

1.5 year

Social & personal development:

At 2m	smiles in response to stimuli
4m	laughs on social contact & prefer social contact.
4-5m	recognizes his mother
10 ms	respond to his name – wave bye bye
12 ms	simple ball games.

Feeding:

The child feeds himself from the age of 2.5 yr.

**Dressing:**

Can dress himself at the age of 3 yr.

Sphincteric control:

- ❖ Automatic bladder (local spinal reflex) during the 1st year.
- ❖ The mother trains her baby to sit on the potty at 5-6 months $\Rightarrow$ conditioned reflex on touching the potty.
- ❖ Early voluntary control (incomplete) starts at 15 - 18 mo $\Rightarrow$ the baby aware of being wet, Asks to go but usually late (no voluntary inhibition).
- ❖ At the age of 2 years $\Rightarrow$ calls before & controls by day.
- ❖ At the age of 3 years $\Rightarrow$ dry by day & night.
- ❖ A child's average bladder capacity = (age in years +1) X 30 = average voided volume
- ❖ Urine is produced from the kidney is about 60 ml/hr

Special senses:

Taste: present since birth.

Vision:

- ❖ He can see at birth with diminished visual acuity.
- ❖ Can fixate on moving objects at 1 month.
- ❖ Can follow moving objects 180 degrees.
- ❖ Proper coordination of eye movements at 4-6 ms.

Hearing:

- ❖ At birth: can hear without following the source of sound.
- ❖ At 6 months: following the source of the sound.



Puberty

Definition

Transition period between childhood & adulthood periods during which reproductive function is attained.

Changes occurs during this periods

- ❖ The secondary sexual characteristics appear.
- ❖ Adolescent growth spurt occurs.
- ❖ The gonads start to produce mature gametes.
- ❖ Major physiological changes occur.

Physical Changes of puberty

Pubic hair development

Tanner I	Non
Tanner II	Few darker hair along labia or at the base of the penis
Tanner III	Curly pigmented hairs across pubes
Tanner IV	Small adult configuration
Tanner V	Adult configuration with spread to inner thigh & may spread to linea alba in some males

Male genital development

Tanner I	Prepubertal
Tanner II	Testes enlarge (4ml); scrotum larger, reddened and skin coarser
Tanner III	Penis enlarges, initially in length, continued growth of testes and scrotum
Tanner IV	Penis growth in length & breadth; continued growth of testes & scrotum that becomes pigmented
Tanner V	All are in adult size

Female breast development

Tanner I	Prepubertal
Tanner II	Areola enlargement with breast bud
Tanner III	Enlargement of breast and areola as single mound
Tanner IV	Projection of areola above breast as double mound
Tanner V	Adult; papilla projects out of areola that is part of breast contour

Precocious puberty:

If these changes are noted prior to 8 years in girls & 9 years in boys.

Delayed puberty:

If these changes do not occur up to 13 years in girls & 14 years in boys.

Hormonal Changes of puberty

- ❖ Adrenarche: increase DHEA-S production by zona reticularis of adrenal gland, precedes the onset of puberty.
- ❖ Gn-RH secretion by the hypothalamus is responsible for initiation of puberty under the effect of plethora of central & peripheral signals: excitatory amino acids, other neurotransmitters such as GABA, gonadal sex steroids, adrenal & thyroid hormones.....etc

Enuresis

Definition

Inability to control urination till the age of 5 years

Classifications

- I. Primary or secondary:
 - ❖ Primary: the child has never controlled before.
 - ❖ Secondary: The child has achieved voluntary control for at least 6 months
- II. Nocturnal or Diurnal:
 - ❖ Nocturnal: failure of control only during sleep.
 - ❖ Diurnal: failure of control only during day & night.
- III. Monosymptomatic or Polysymptomatic:
 - ❖ Monosymptomatic (MNE): bed wetting without other voiding disorders.
 - ❖ Polysymptomatic (PNE): associated with bladder symptoms as urgency.

Monosymptomatic Nocturnal Enuresis

Etiology

1. Psychological factors: stressful circumstances as;
 - ❖ Aggressive parents.
 - ❖ Coming of new sibling.
 - ❖ Loss of one of the family.
2. Loss circadian rhythm of ADH: $\Rightarrow$ nocturnal Polyuria.
3. Excessive fluid intake at night.
4. Maturation & developmental delay: delayed recognition & response to full bladder.
5. Genetic factors: if there is associated family history.
6. Functional bladder capacity: $\downarrow\downarrow$ functional capacity of the bladder.
7. Sleep arousal dysfunction: deep sleep or arousal disturbances & delay in perception of bladder fullness.

D.D.

1. Enterobiasis.
2. Diabetes mellitus or insipidus.
3. Urinary tract diseases.
4. Spina bifida with fibrous tissue stretching the spinal cord.
5. Anomalies in the sphincter.

Diagnosis

History:

- ❖ Developmental milestones & voiding history.
- ❖ Drinking & sleep habits.
- ❖ Stressful conditions.
- ❖ Symptoms of UTI.
- ❖ Symptoms of DM or DI.

Examination:

- ❖ Swelling in the back.
- ❖ Neurological examinations.
- ❖ External genitalia for congenital anomalies.

- ❖ UT examinations.

Investigations

- ❖ Urine analysis: for pus cells, glucose, specific gravity.
- ❖ Stool analysis: parasitic ova.
- ❖ Pelvi-abdominal & post voiding sonar.
- ❖ IVP
- ❖ X-ray lumbo-sacral spine.
- ❖ Voiding cystourethrography.
- ❖ Urodynamic study.

Treatment1. **Training & advices:**

- ❖ Behavior modification.
- ❖ Fluid intake program.
- ❖ Bladder training (hold urine during day).
- ❖ Frequent voiding before sleep.
- ❖ Awakening child for voiding.

2. **Psychiatric management:** of child & parents.3. **Arousal systems:**4. **Drugs:**

- ❖ Antibiotics if UTI.
- ❖ Anticholinergics.
- ❖ Tricyclic antidepressant.
- ❖ ADH.